

# Europe's Leading Foundry

# OMMIC

“100nm GaN on Si Technology for  
mmW 5G Application and SATCOM”

EDICON  
April 1st 2019





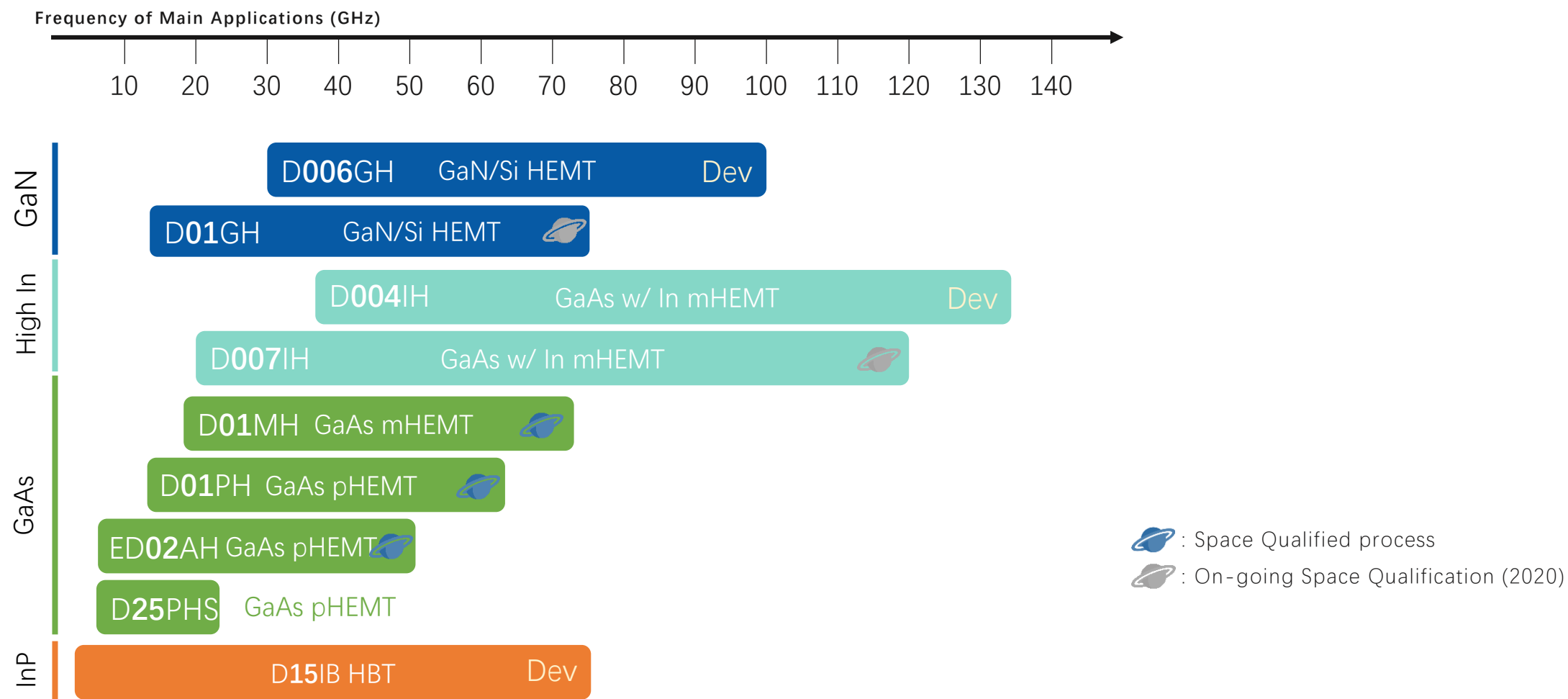


# 1<sup>st</sup>

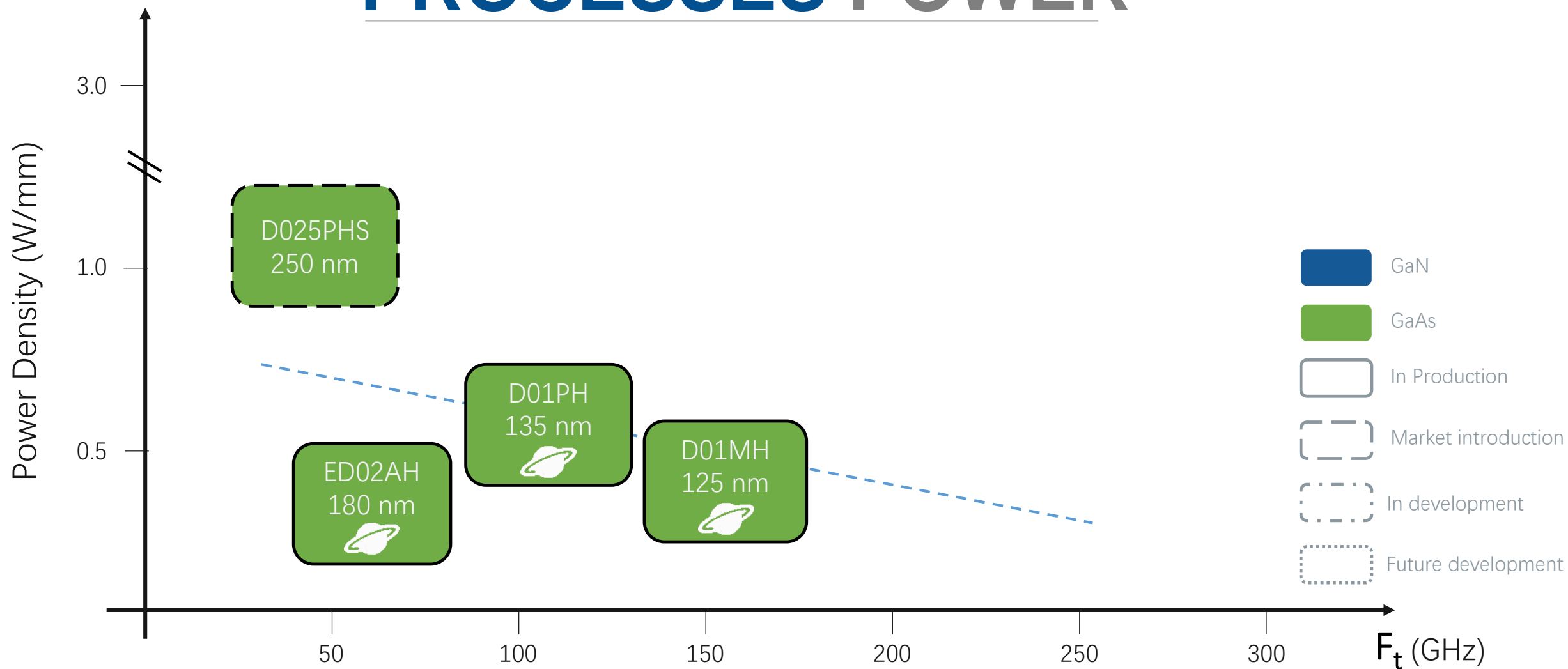
## 6 Inch GaN line in Europe

- Created in 2000
- Former Philips Semiconductor division
- Over 40 years of experience in III-V semiconductors, including GaAs and InP
- Unique GaN Process best suited for upcoming 5G
- Only foundry in Europe offering complete service including Epitaxial Growth, Process Development, MMIC Design & Fabrication, Test & Product Qualification

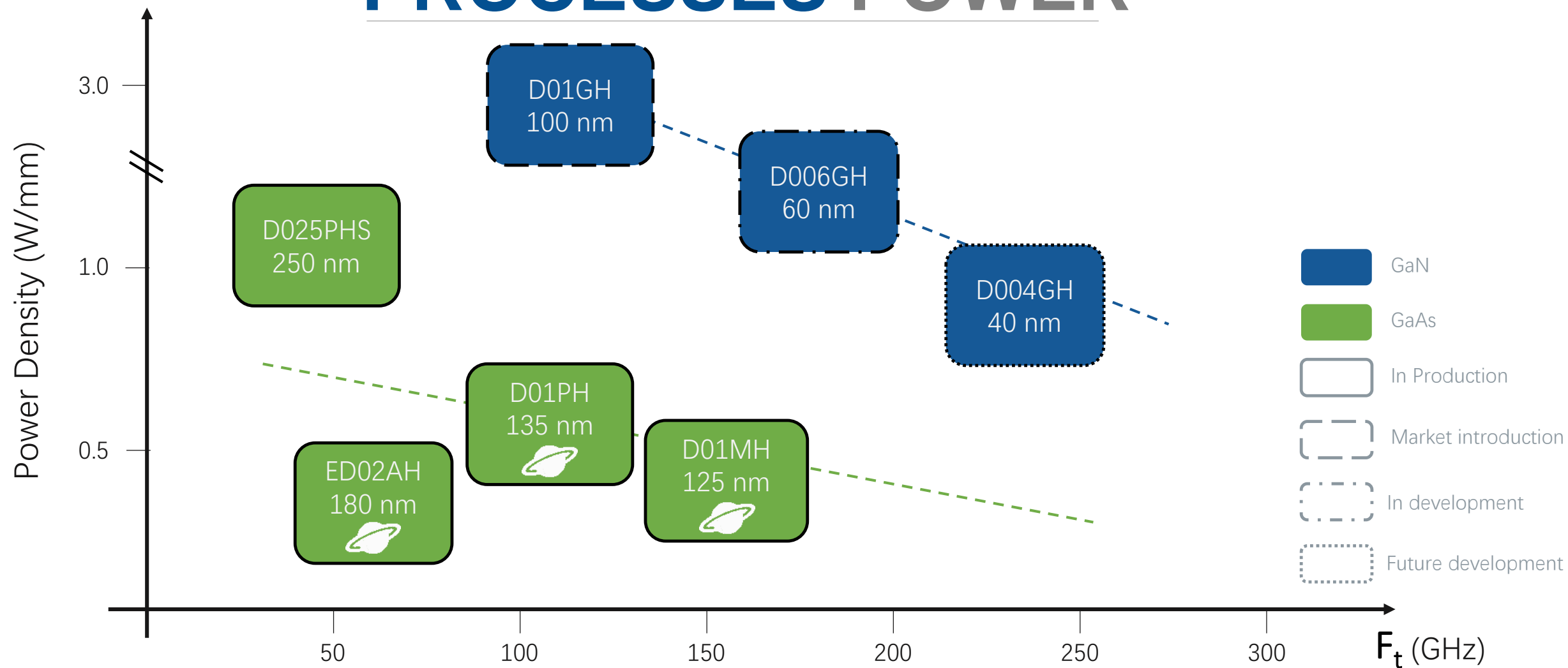
# OMMIC PROCESSES



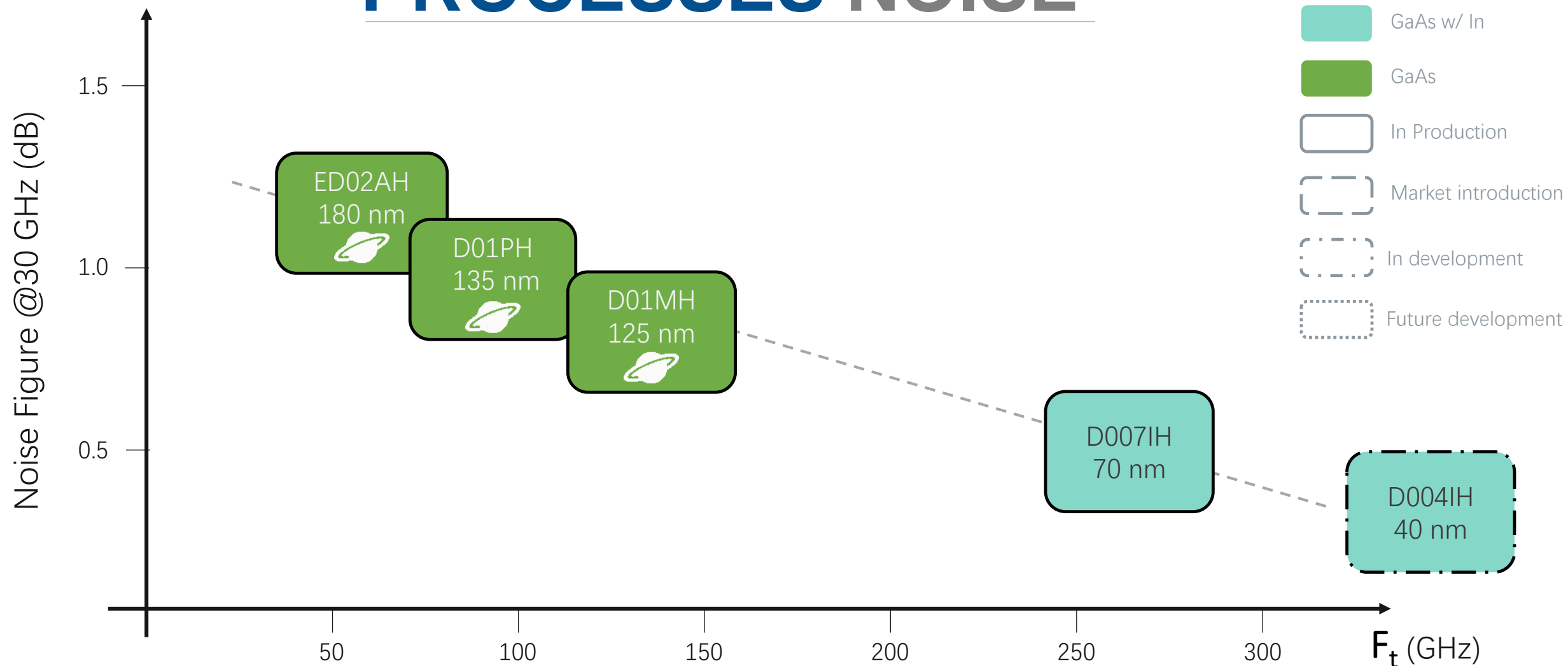
# PROCESSES POWER



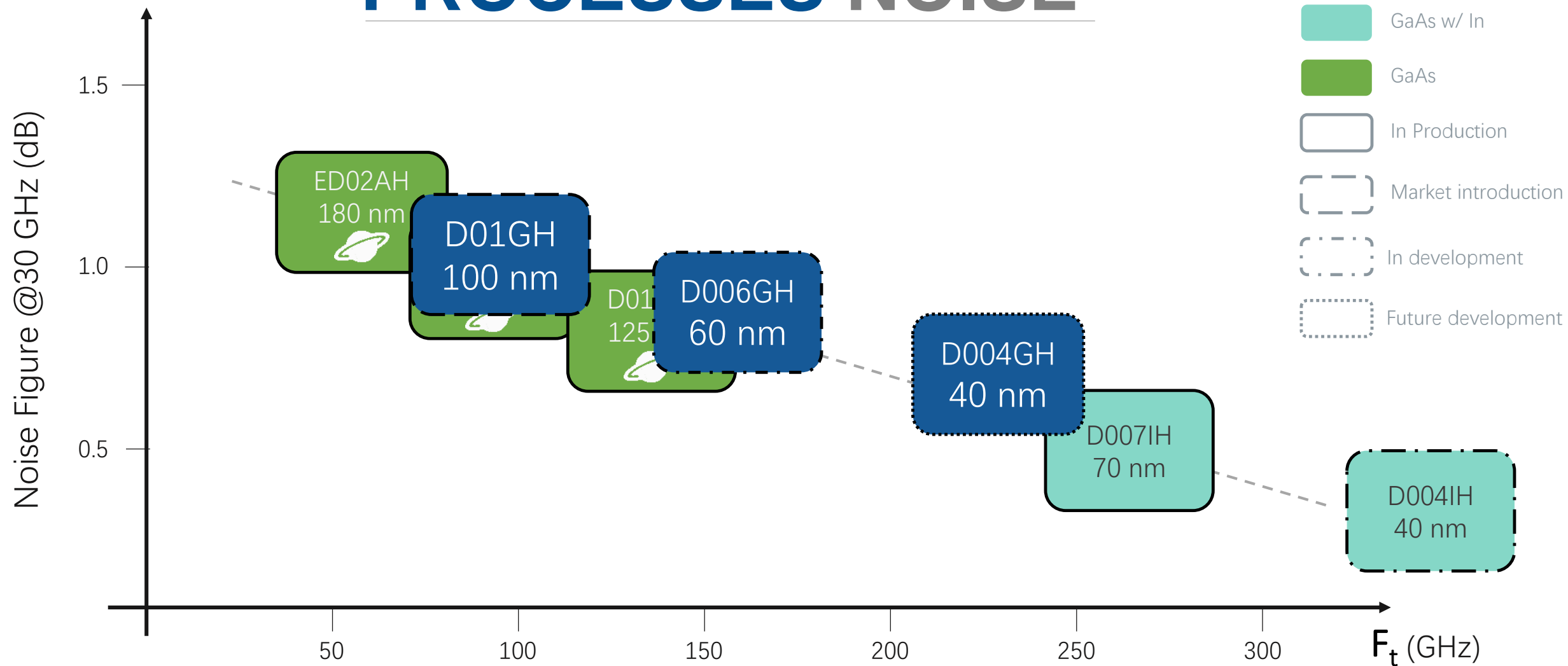
# PROCESSES POWER



# PROCESSES NOISE



# PROCESSES NOISE





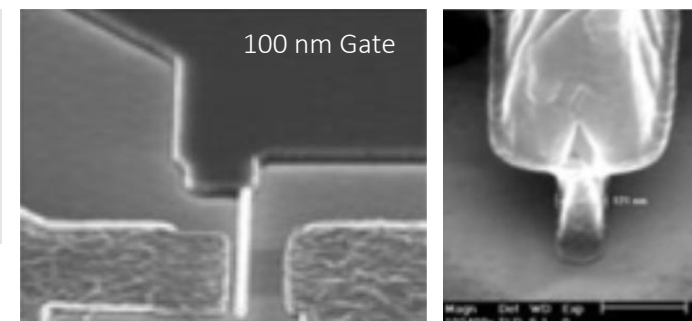
# D01GH GaN/Si



## D01GH FEATURE

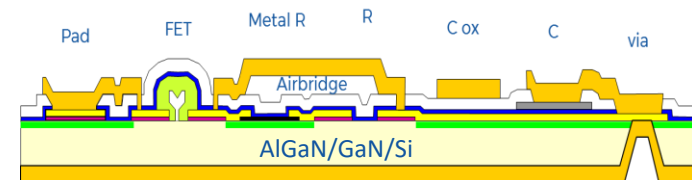
$f_{\max}$  : 180 GHz  
 $f_t$  : 100 GHz

Gate length: 100 nm  
 $V_{\text{bgd}}$  : 40 V



## PRELIMINARY ON-WAFER MEASUREMENTS

PW @ 30 GHz : 3.5 W/mm  
PAE : 48%



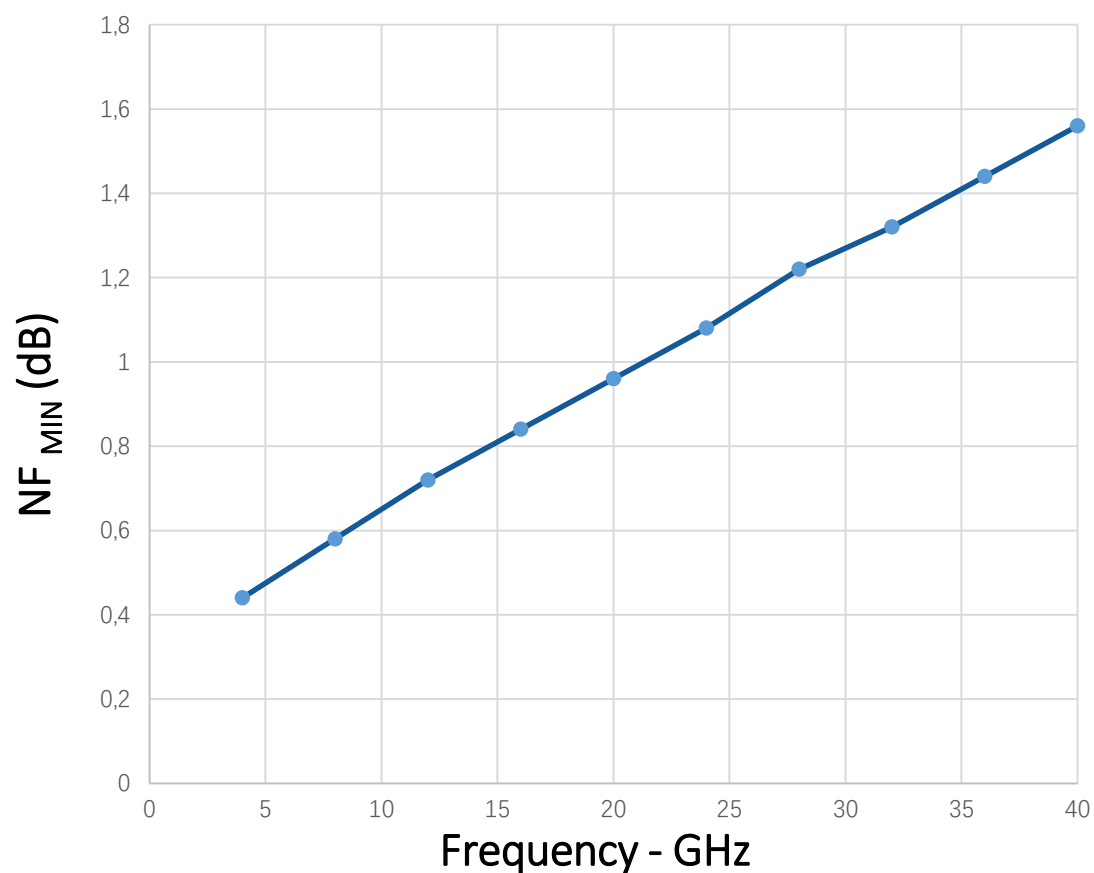
## MAIN APPLICATIONS

- High Linearity Mixers
- High frequency PA 15 GHz to 50 GHz
- Instrumentation wide band amplifier DC - 50 GHz
- Robust LNA (< 40 GHz) : up to 35dBm Pin CW for



# D01GH GaN PROCESS

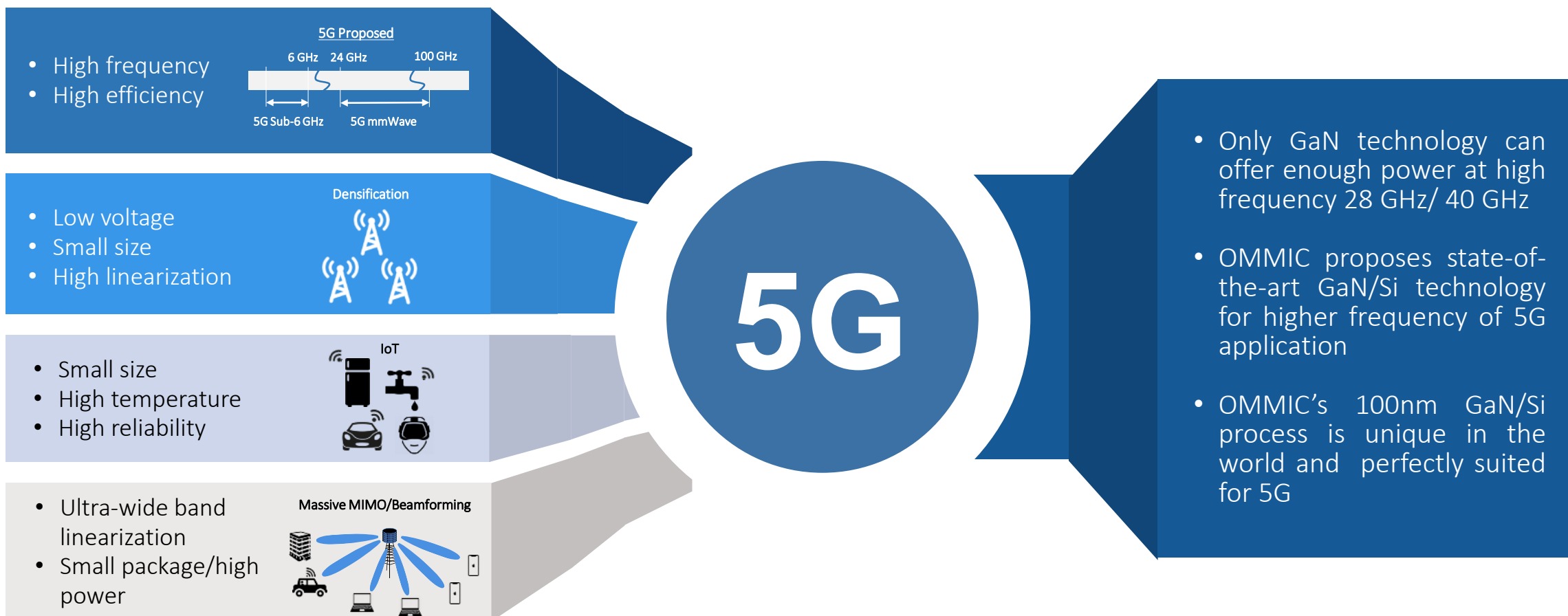
D01GH  $NF_{min}$  v.s. Freq



GaAs v.s GaN

	D01PH	D01GH	D01MH
	GaAs pHEMT	GaN/Si HEMT	GaAs mHEMT
	135 nm	100 nm	120 nm
$V_{ds}$ (V)	3	5	1
$I_{ds}$ (mA)	15	42	30
$R_s$ (Ohm)	1,0	1,2	0,8
$R_g$ (Ohm)	0,65	0,70	0,7
$NF_{min}$	1,72 dB	1,54 dB	1,13 dB
Associated Gain	4,5 dB	8 dB	12,4 dB

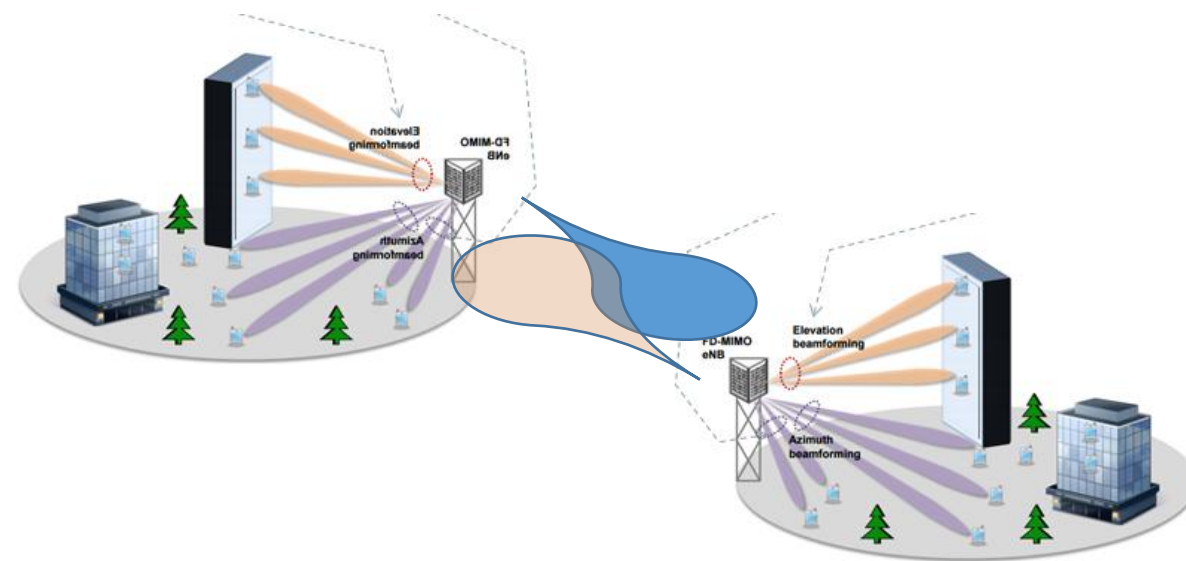
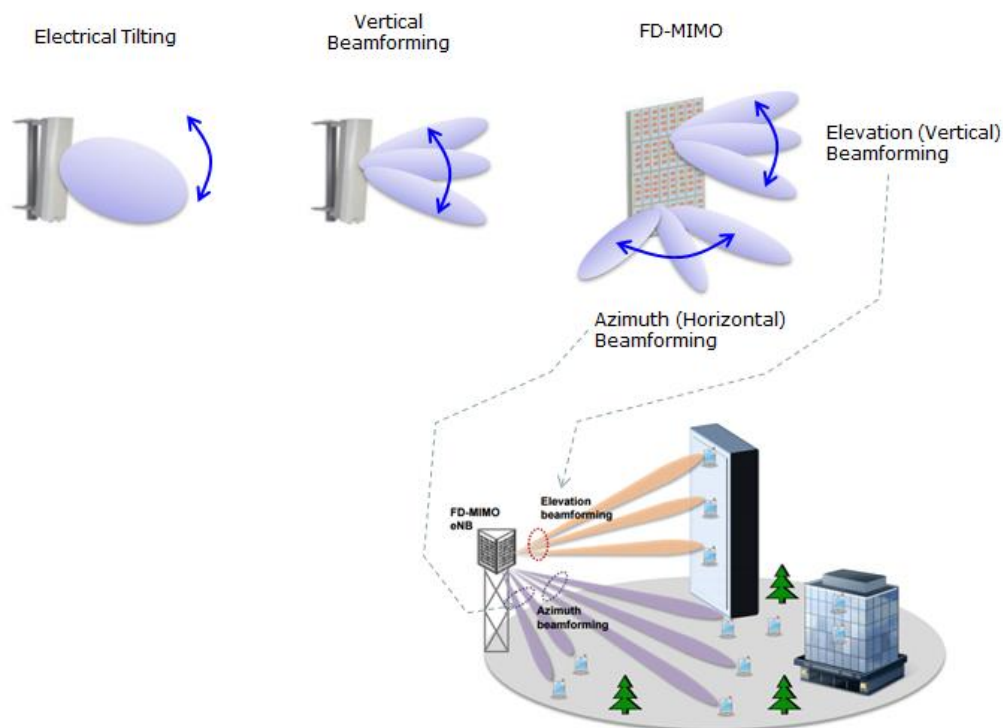
# GaN/Si FOR 5G



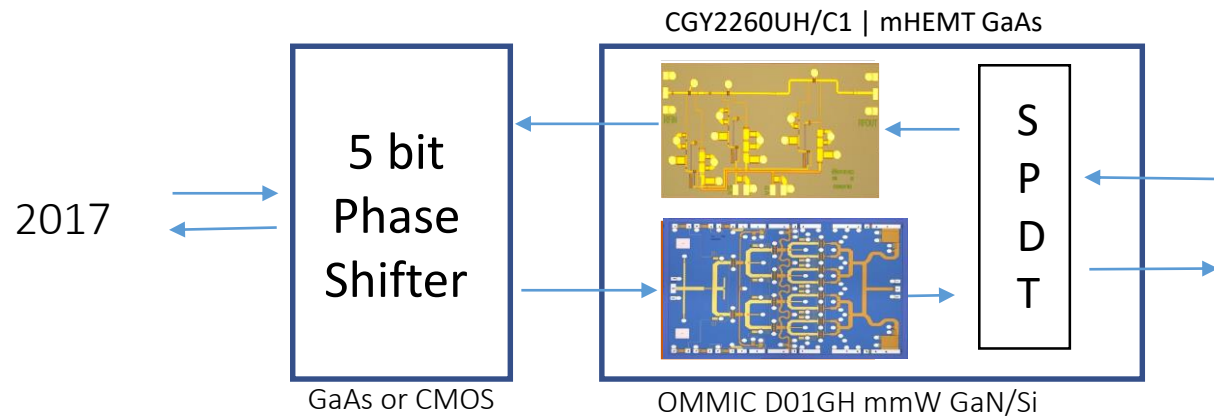
# GaN/Si for mmW 5G

Massive MIMO mmW transceiver (28/40GHz)

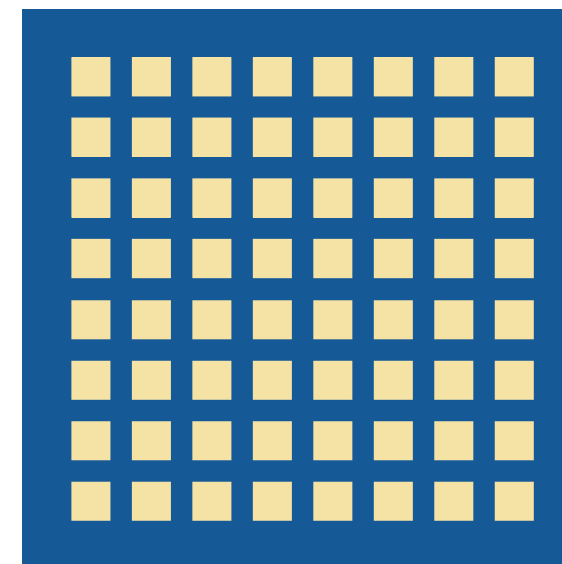
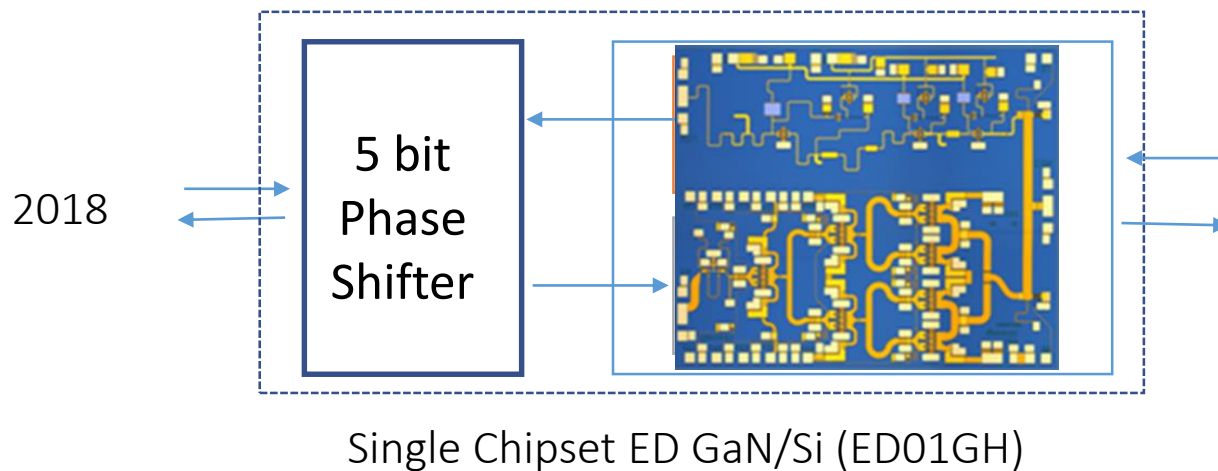
Point to Point radio backhaul (71-76GHz)



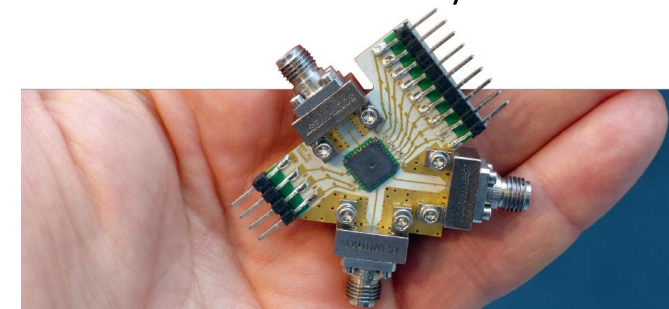
# 5G GaN SOLUTION



Two-die Chipset



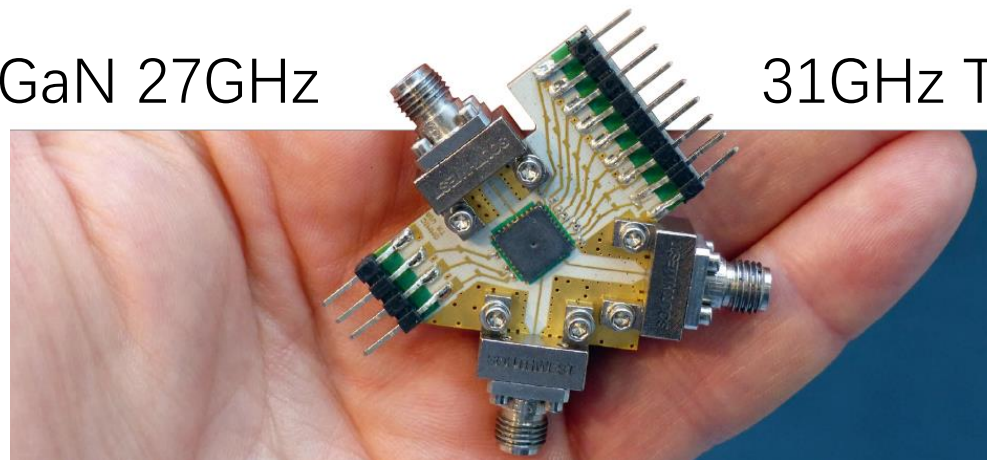
Massive MIMO Array Antenna



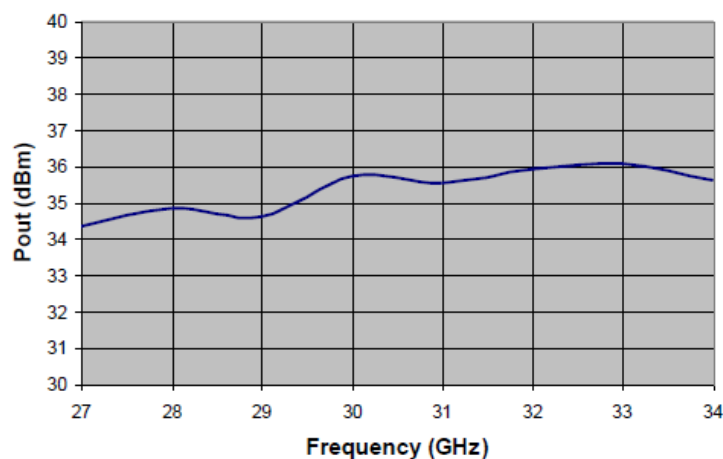
# 5G MAJOR REALISATION

Best GaN 27GHz

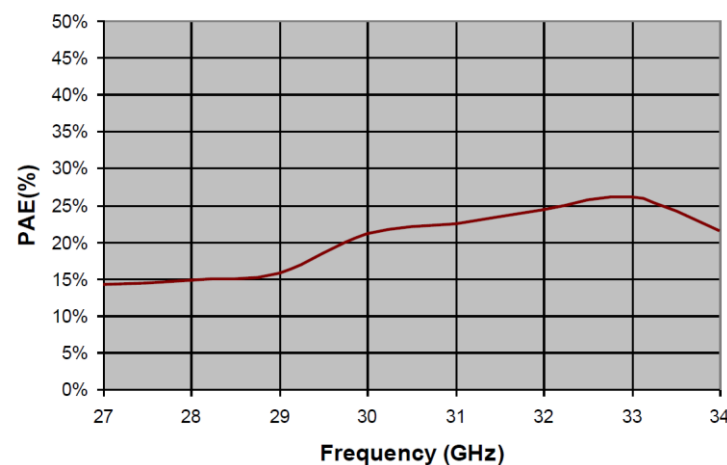
31GHz T/R chip



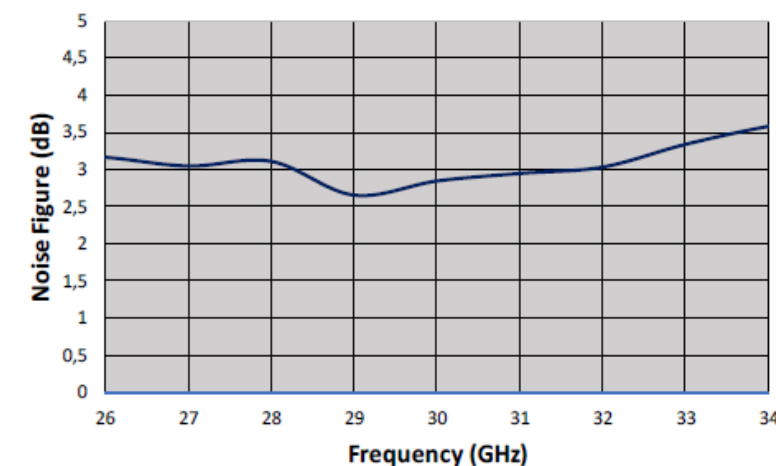
Output power - TR Chip incl Switch



PAE - TR Chip incl Switch



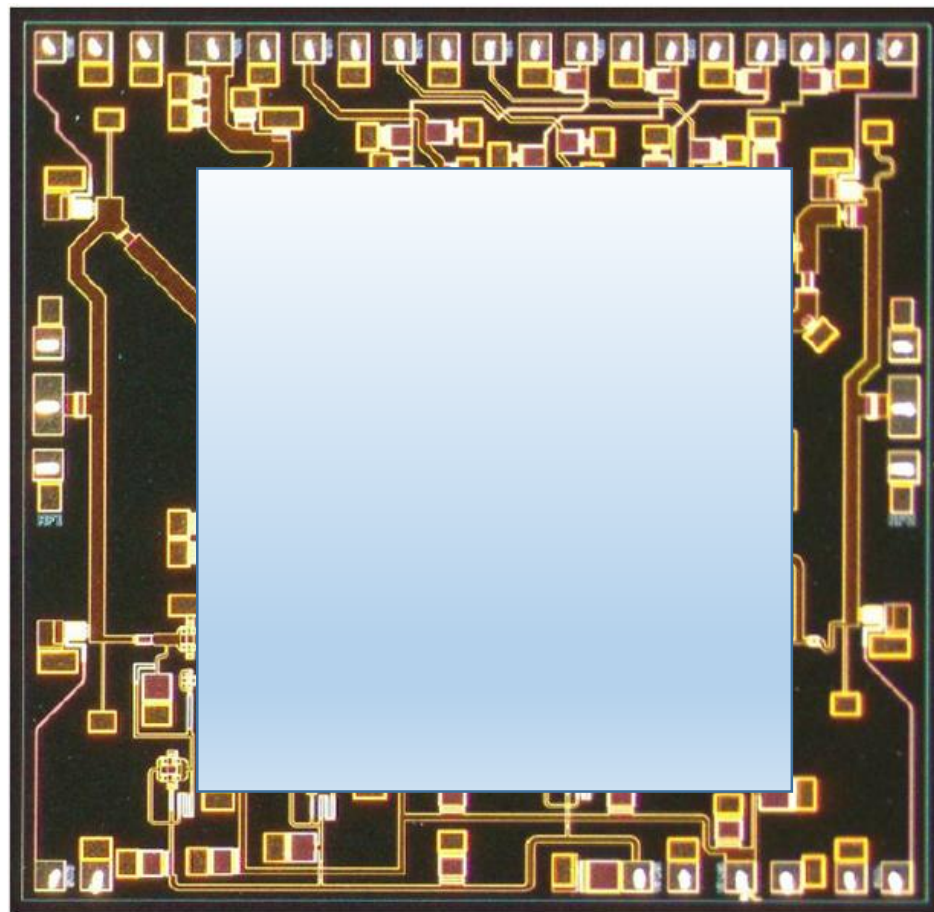
T/R Chip receive mode (Switch+LNA)





# 5G MAJOR REALISATION

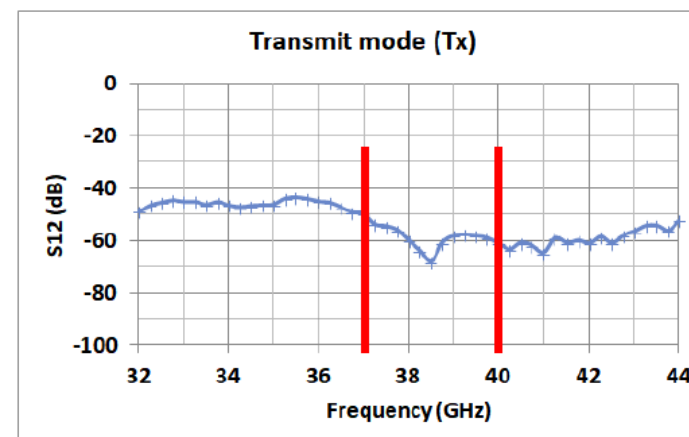
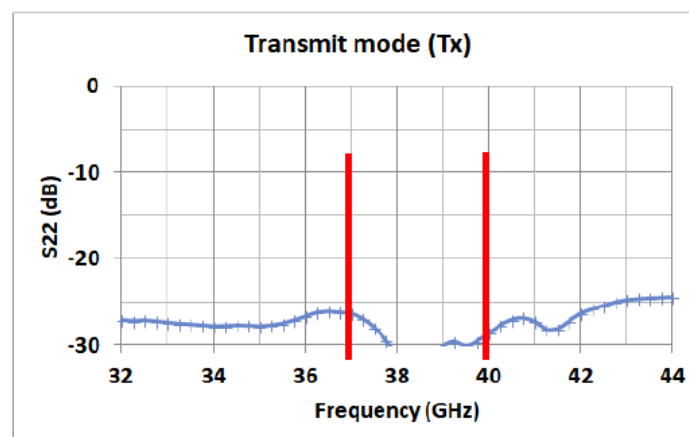
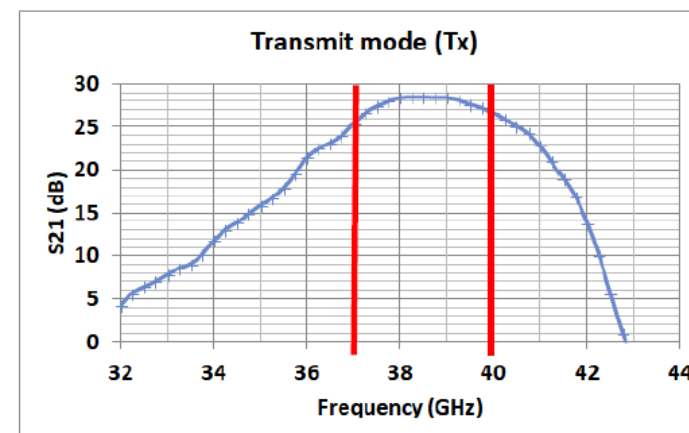
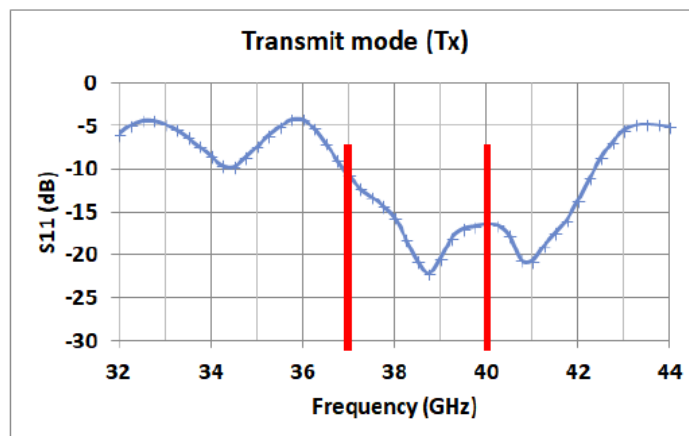
37-40GHz 4W T/R chip\*



\* H2020 Project SERENA

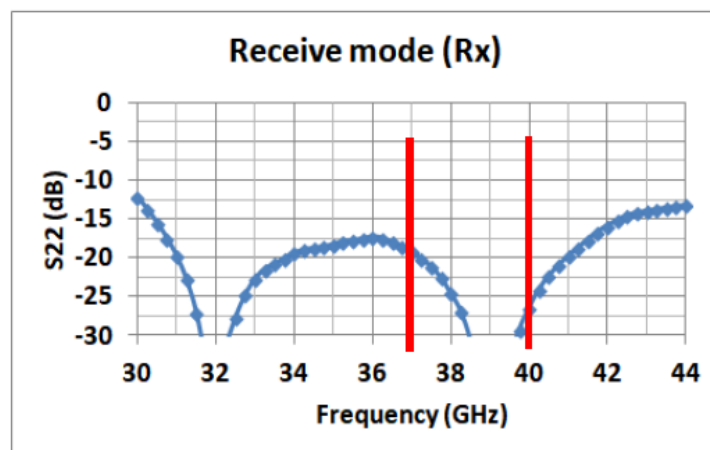
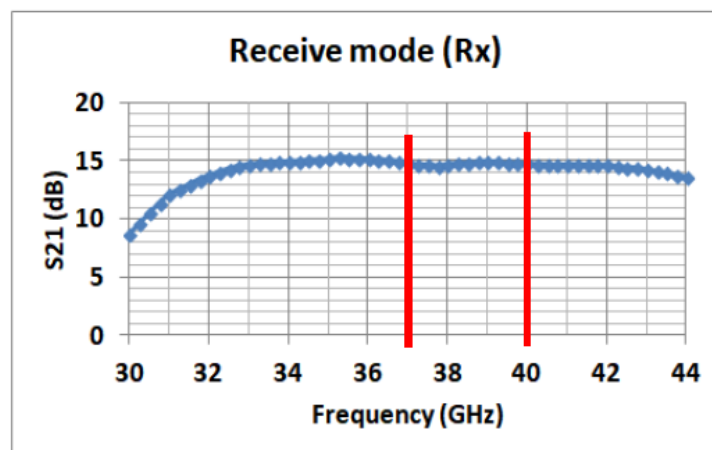
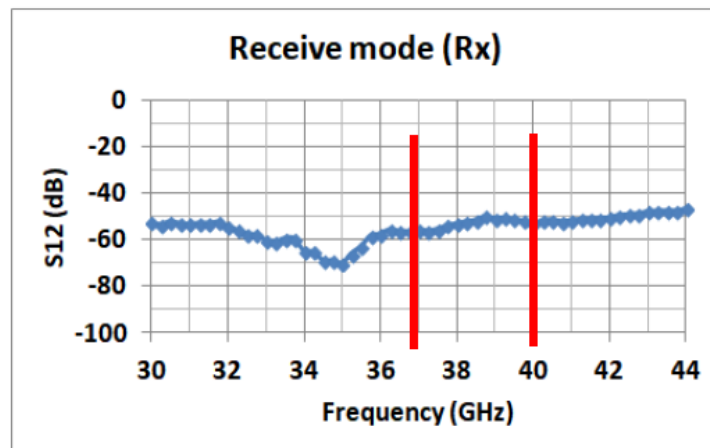
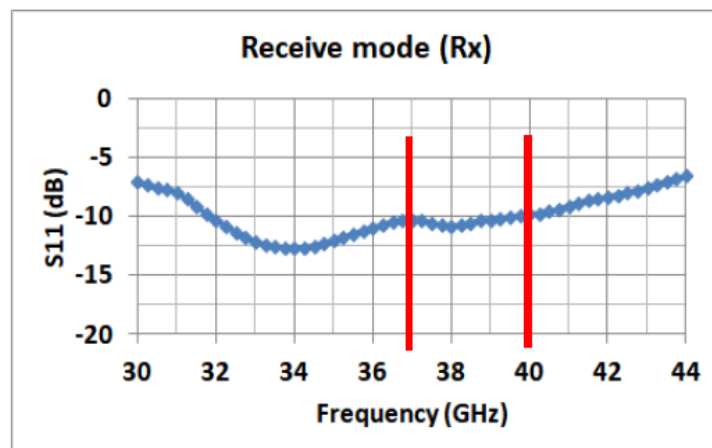
# 5G MAJOR REALISATION

37-40GHz 4W T/R chip

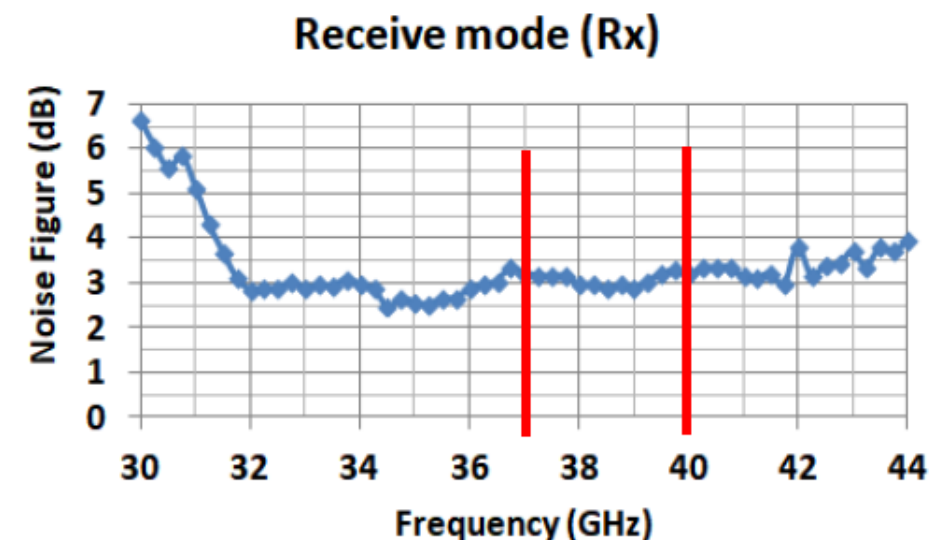


# 5G MAJOR REALISATION

37-40GHz 4W T/R chip

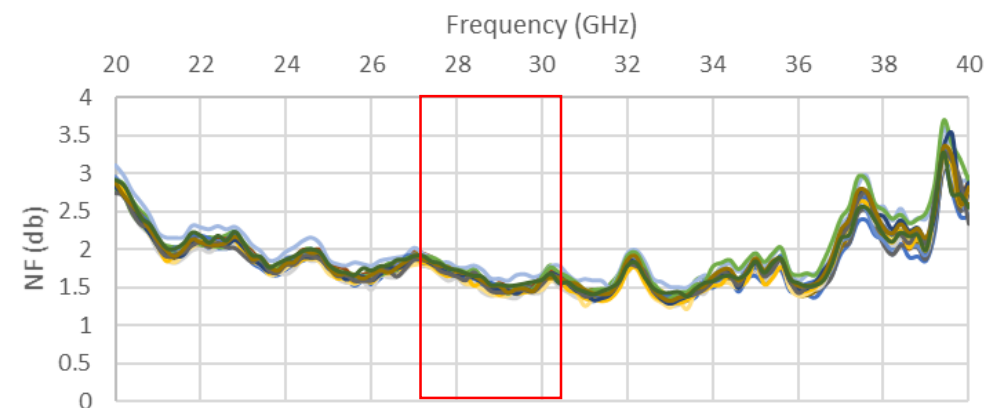
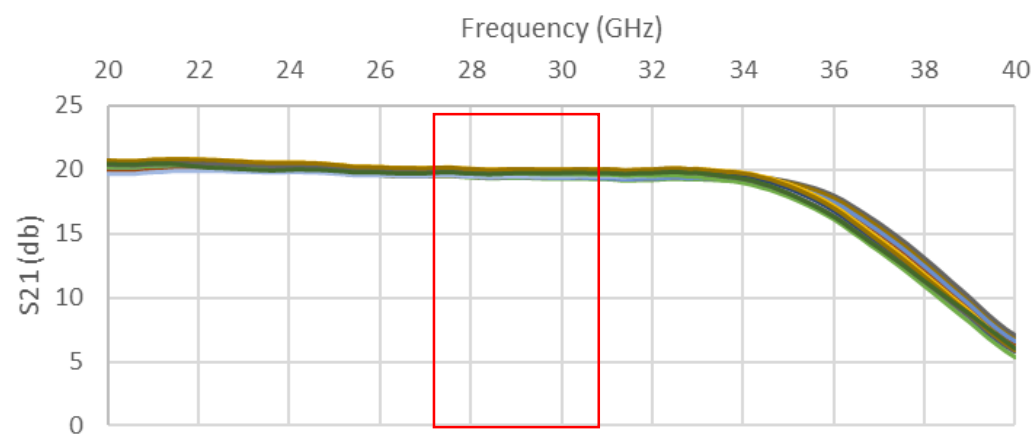


Including switches

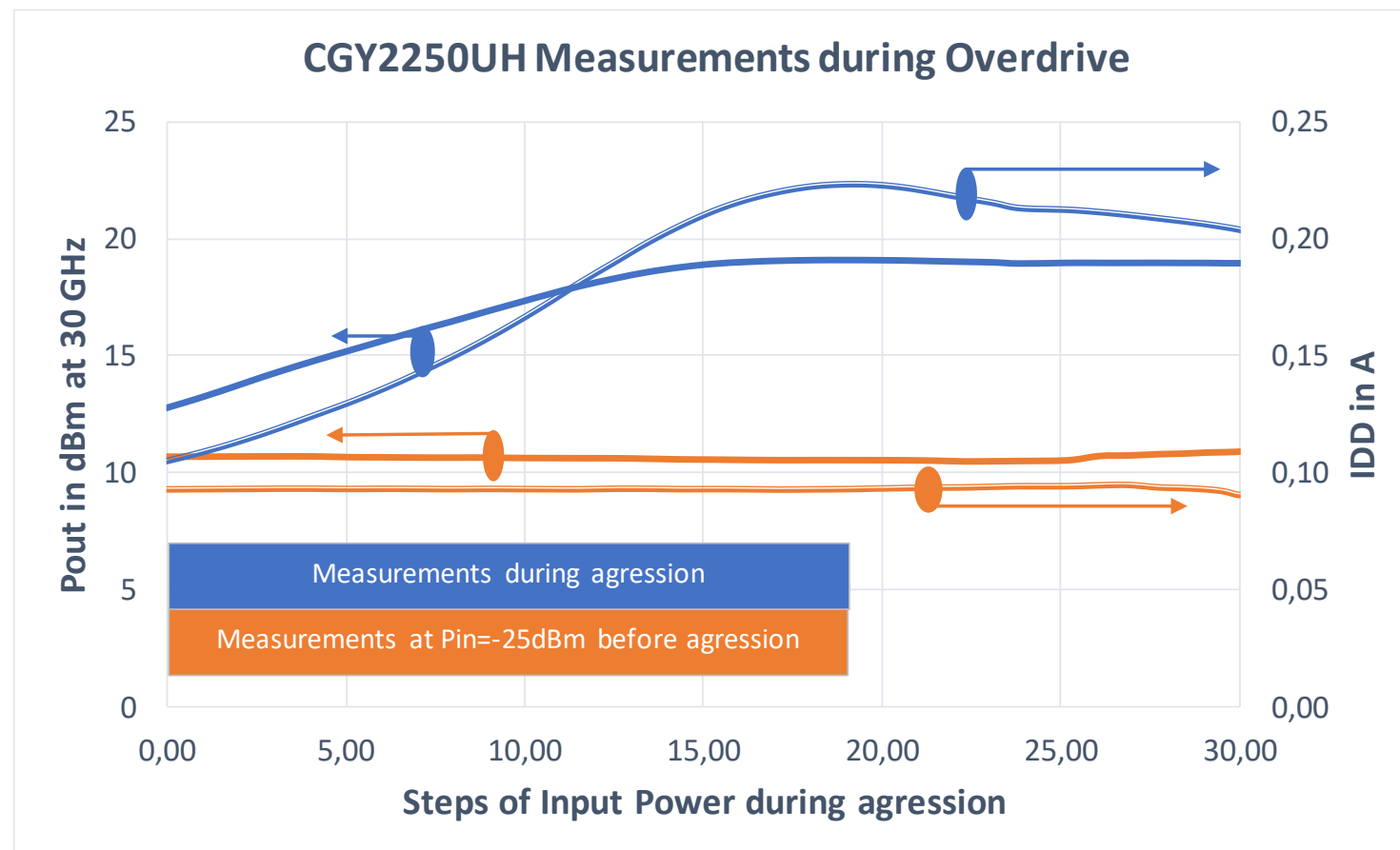
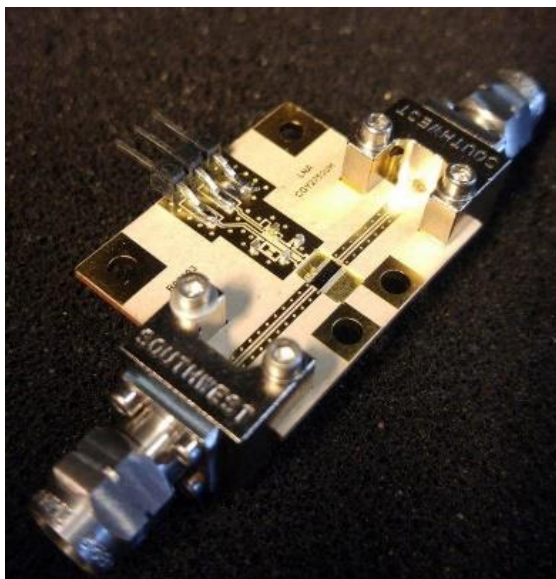
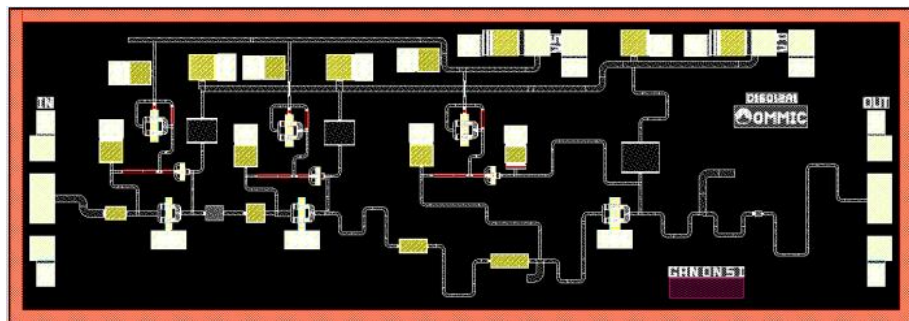


# MAJOR REALISATION

Robust Ultra Low Noise 24-34GHz LNA



# MAJOR 5G REALISATION

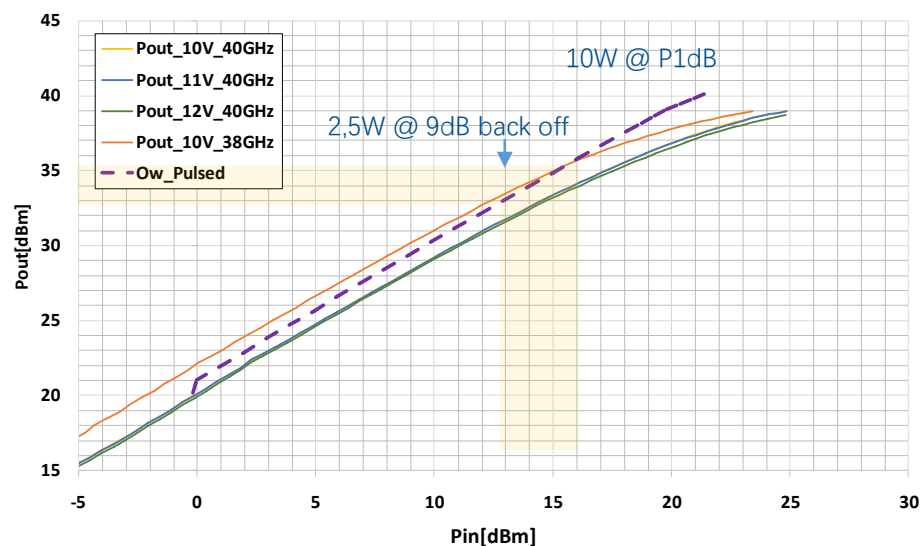




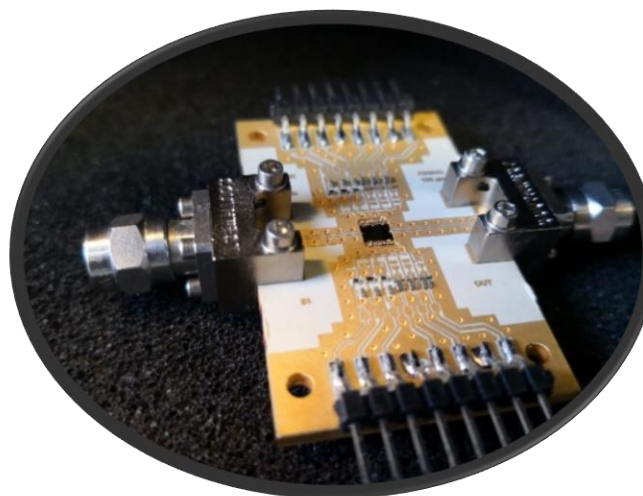
# 5G MAJOR REALISATION

Best GaN 37-43 GHz 10 W PA

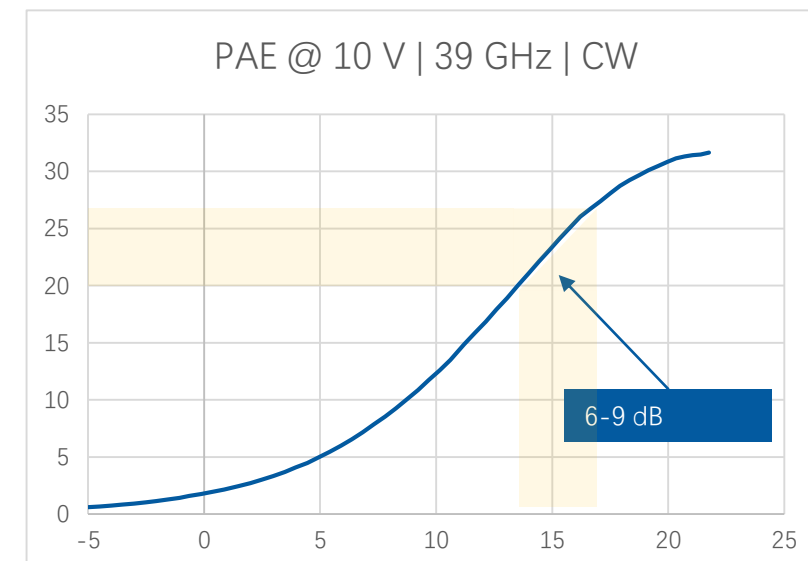
Output Power



Ow pulsed vs. PCB CW



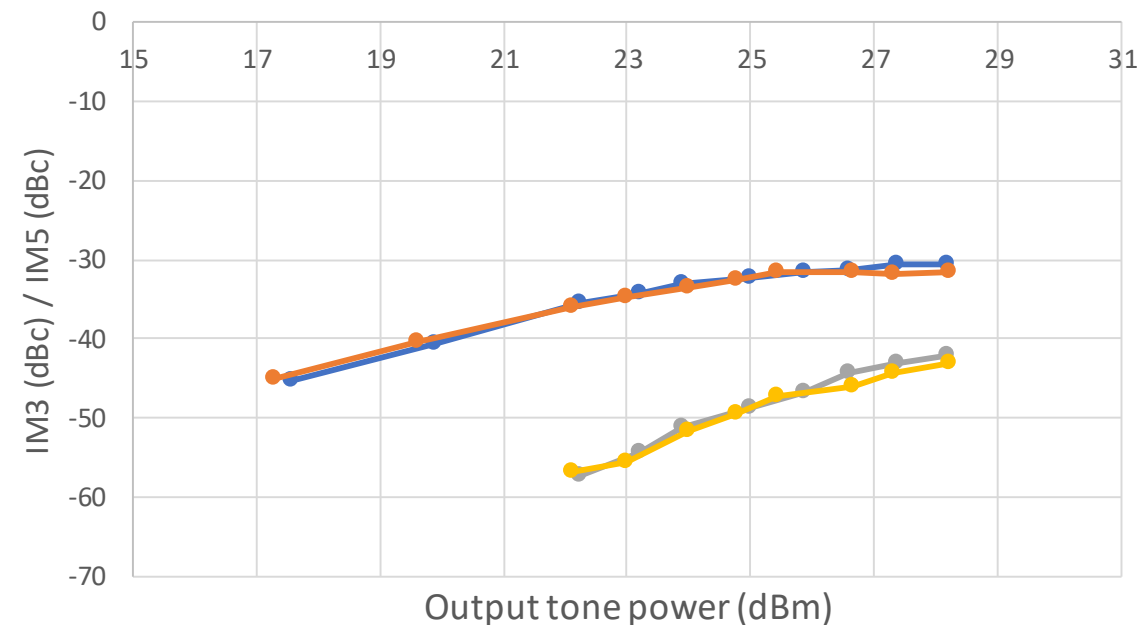
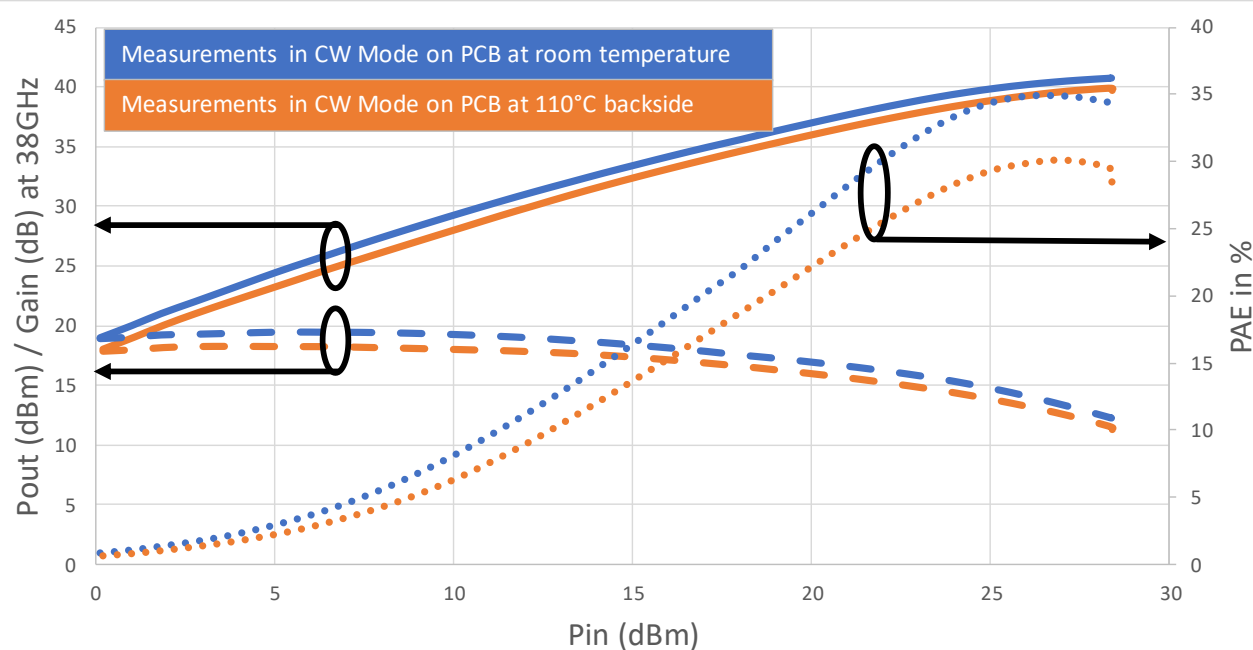
State of the Art Power Efficiency



# 5G MAJOR REALISATION

Best GaN 37-43 GHz 10 W PA

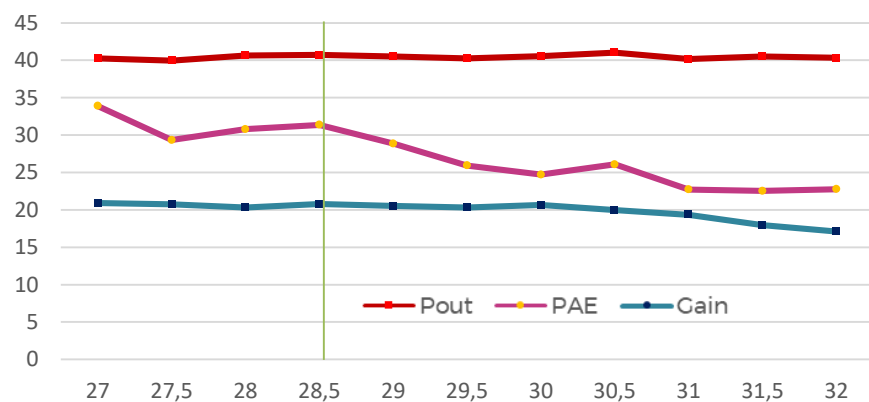
## PCB meas



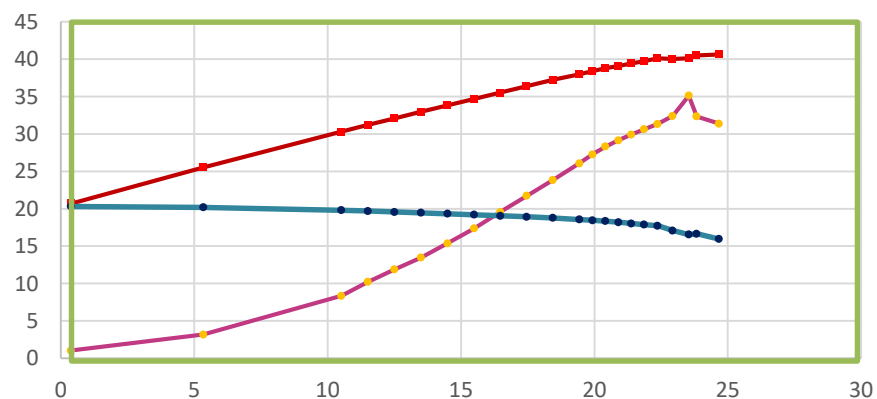
GaN 27-31 GHz 10 W PA

# 5G REALISATION

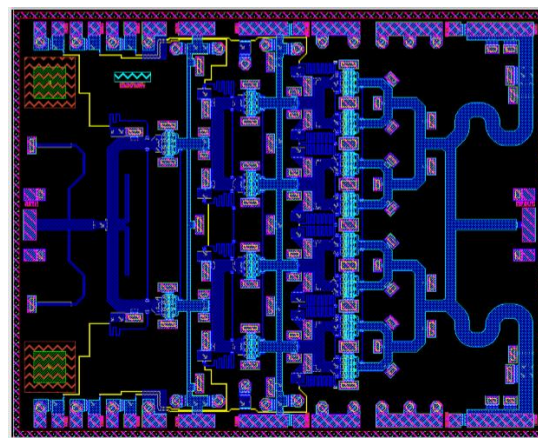
Pout, Gain, PAE vs. Freq



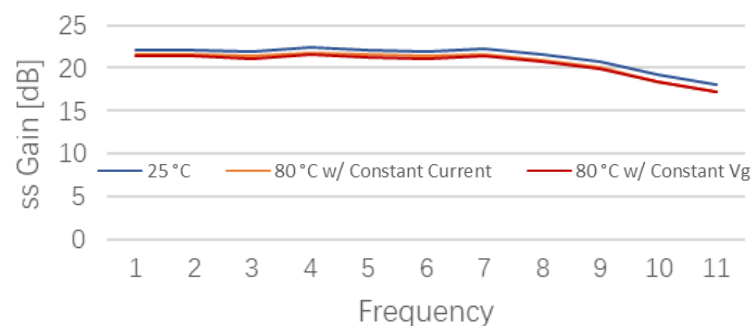
Pout, Gain, PAE vs. Pin



4.4 x 3.5 mm<sup>2</sup>



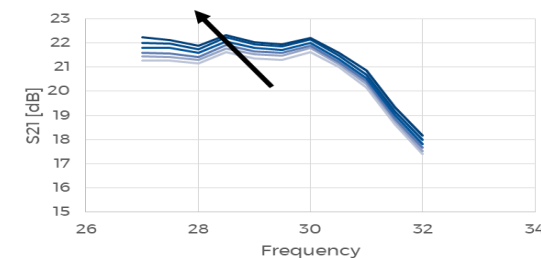
Temperature variation



9 V  
10 V  
11 V  
12 V  
13 V  
14 V

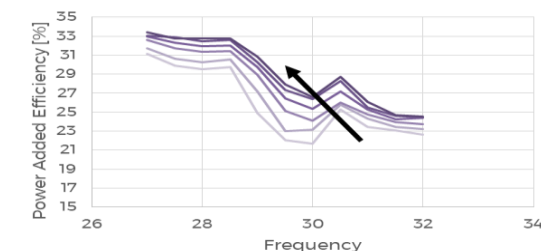
Increasing Vd

ss Gain vs. Freq



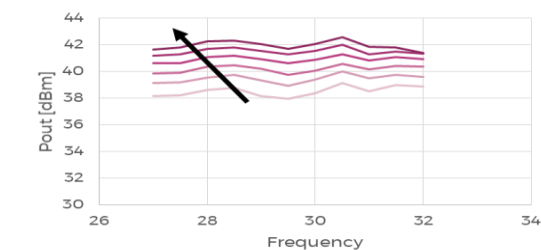
Small signal gain increases with Vd  
~0.1 dB / V

PAE vs. Freq



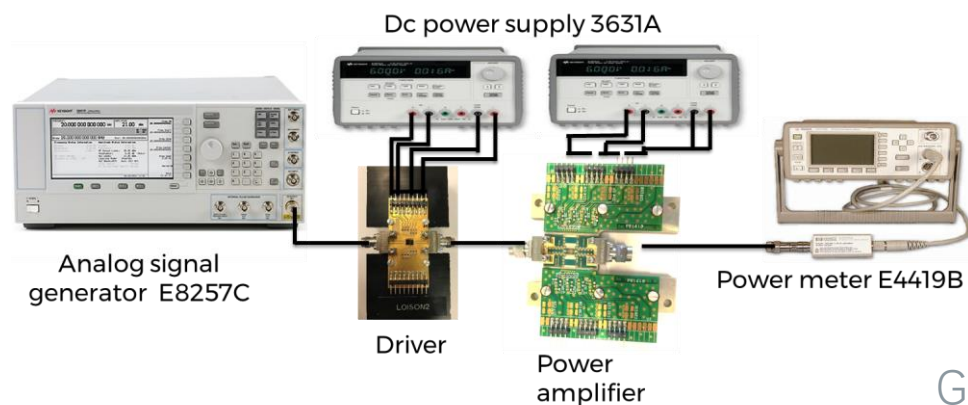
PAE increases with Vd  
~0.5 % / V

Pout vs. Freq

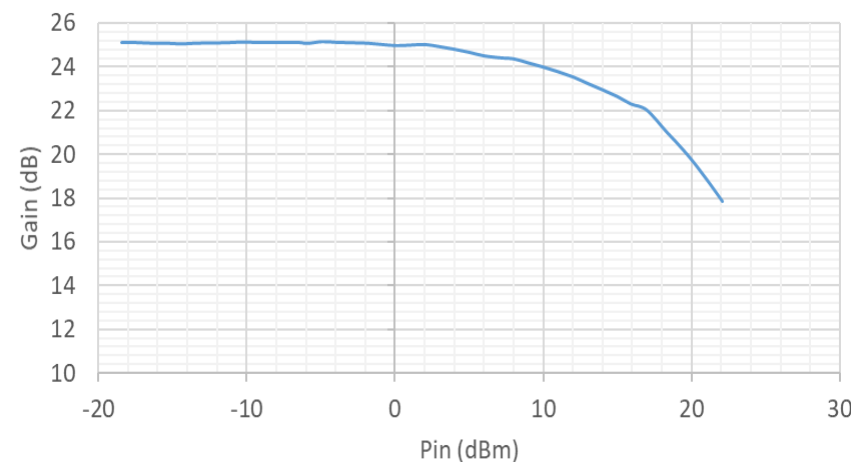
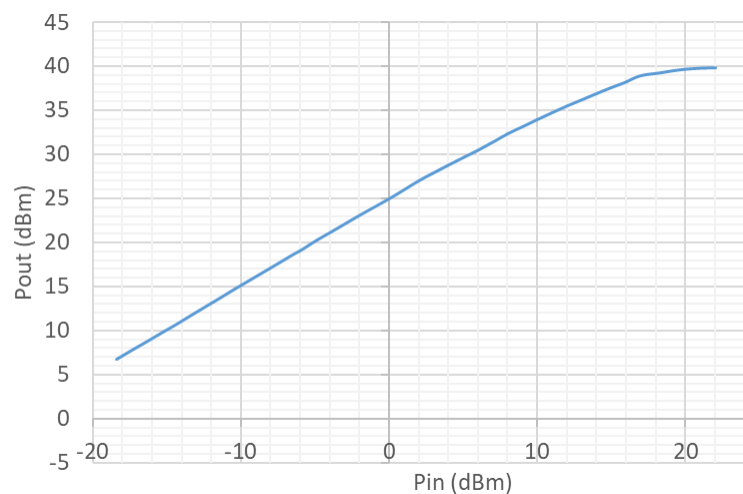


Output power increases with Vd  
~0.5 dBm / V

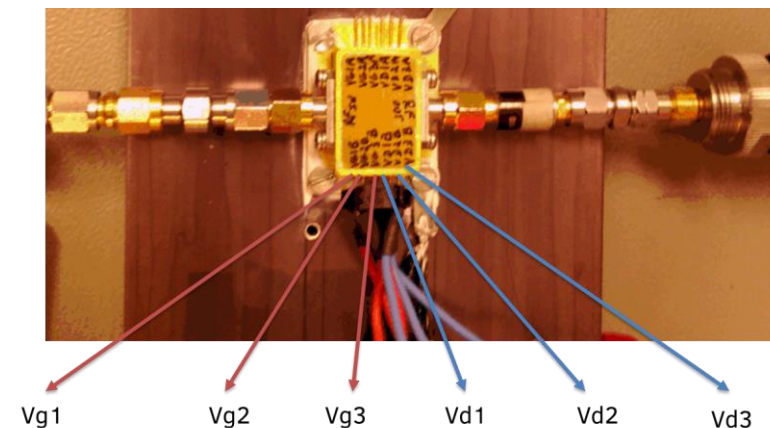
# 5G REALISATION



GaN 30-33 GHz 10 W PA

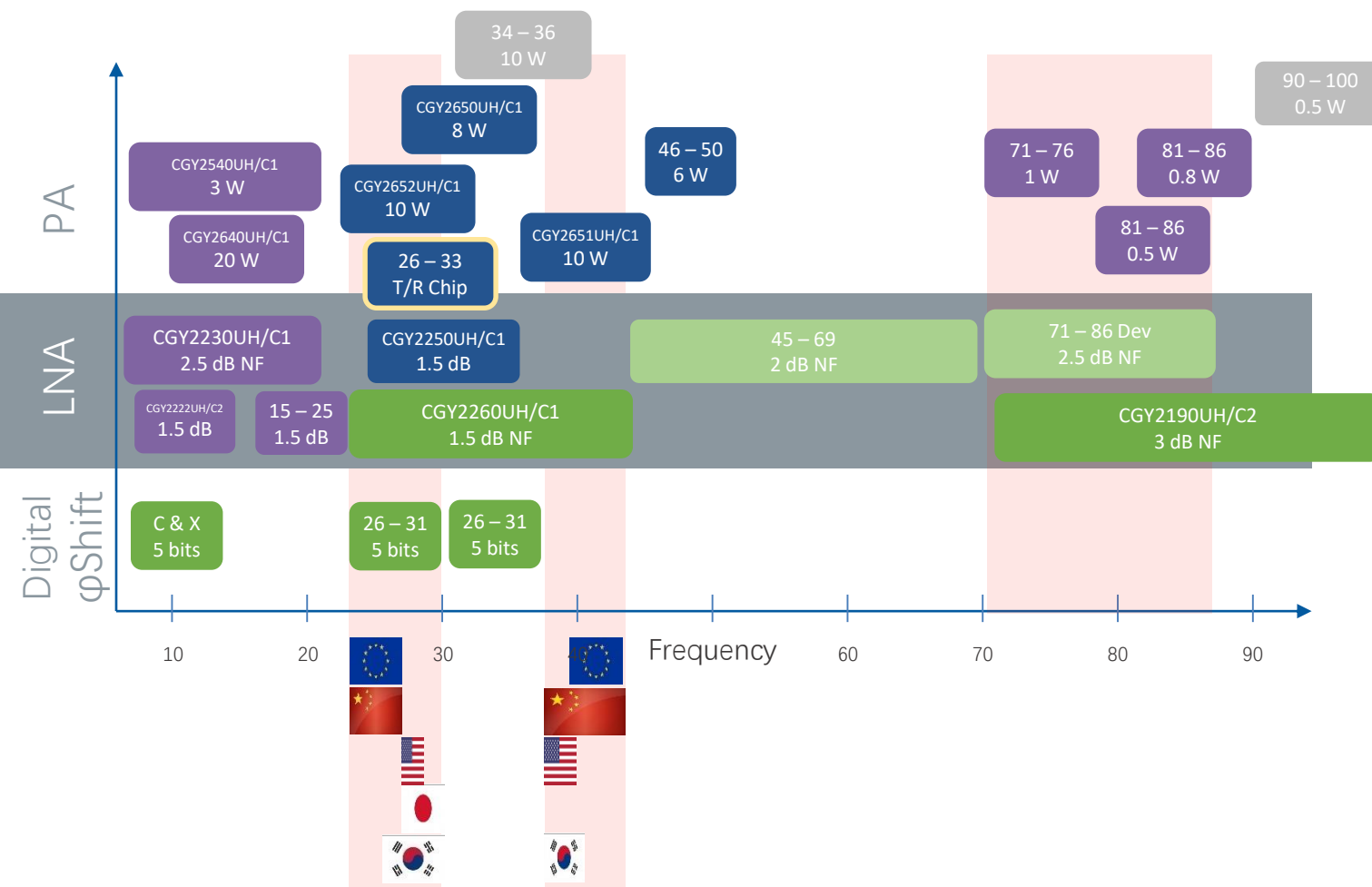


CW measurments / Epoxy Glue



38.8 dBm / 20dB gain / 25.7 % PAE @ 29 GHz

# mmW GaN/Si Product Roadmap

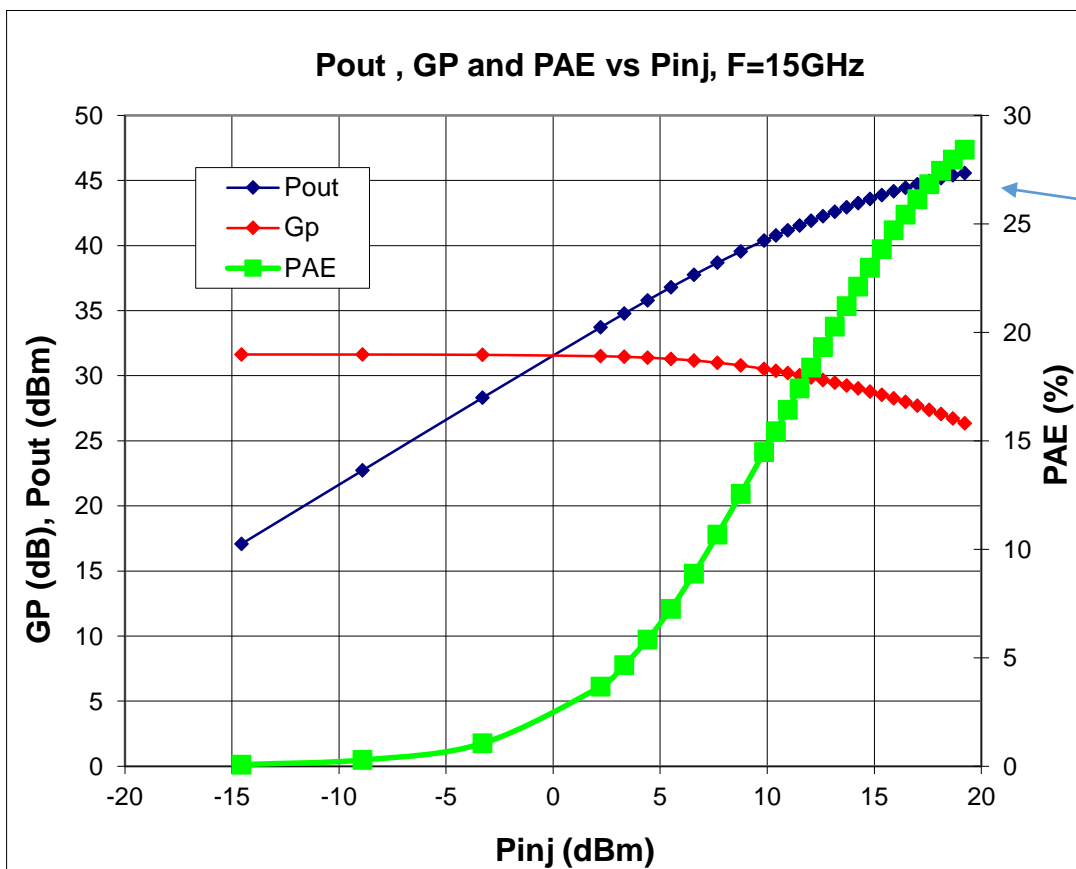


Status	Part nb	Frequency (GHz)	Pout / NF	Gain
TDL		34 – 36	43	22
		90 – 100	27	20
Dev	CGY2540UH	0.5 – 20	35	22
	CGY2640UH	13 – 17	44	32
		71 – 76	28	16
		81 – 86	26	14
Samp	CGY2652UH/C1	27 – 31	40	20
Prod	CGY2650UH/C1	30 – 34	39	22
	CGY2651UH/C1	37 – 43	40	20
		46 – 50	36	18
Dev	CGY2230UH	2 – 20	2.5	17
		8 – 12	1.5	20
		15 – 25	1.5	20
Prod	CGY2250UH/C1	26 – 34	1.6	20
Dev		45 – 69	2	20
		71 – 86	2.2	21
Prod	CGY2260UH/C1	25 – 43	1.5	24
	CGY2190UH/C2	75 – 110	3	23



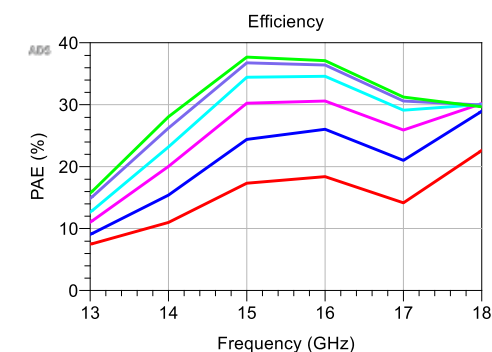
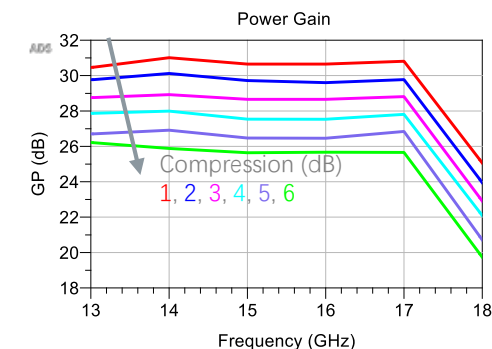
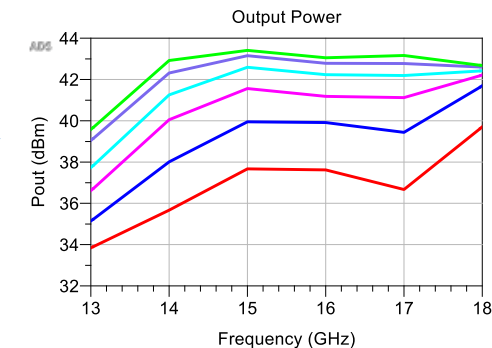
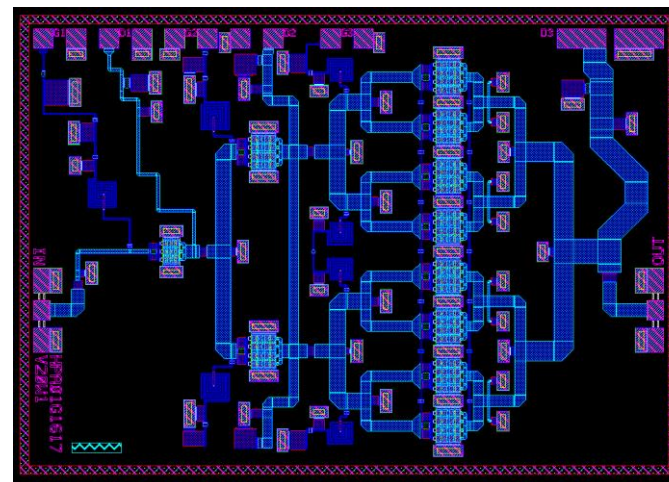
# Ku REALISATION

Pout , GP and PAE vs Pinj, F=15GHz

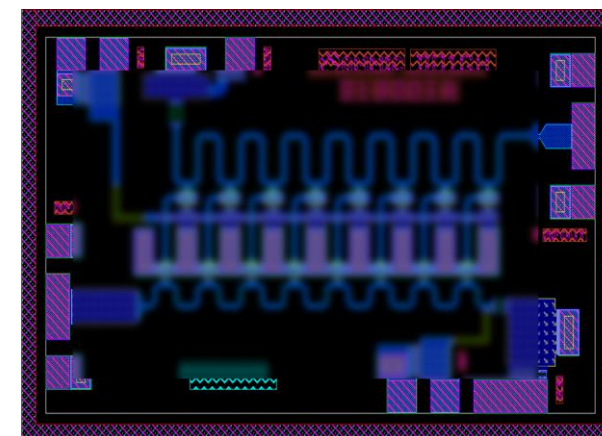
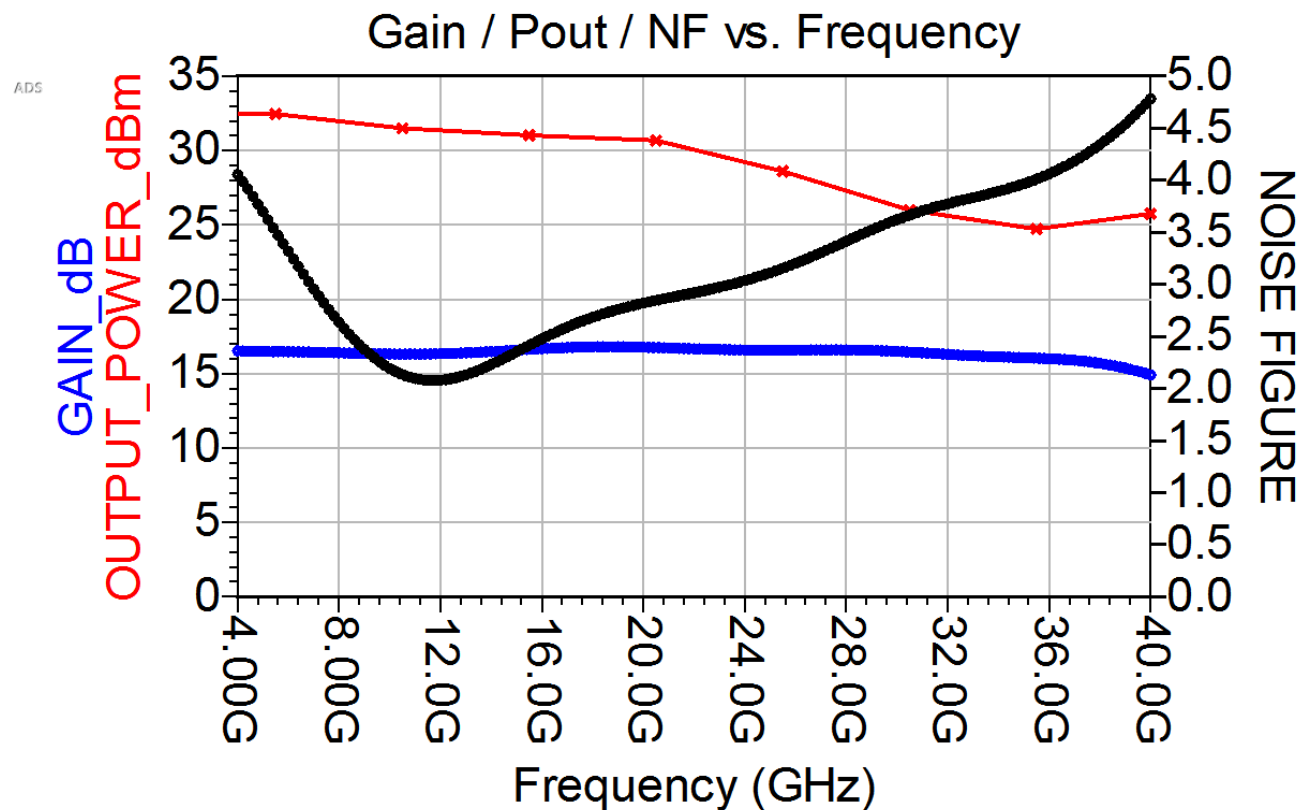


GaN 13-17 GHz 20 W PA

GaN 13-17 GHz 40 W PA



# TWA REALISATION



1.3 x 2.1 mm<sup>2</sup>

18V V<sub>d</sub>



# THANK YOU

[www.ommic.com](http://www.ommic.com)

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